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Free-riding in Student Software Development Teams: An Exploratory Study

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ABSTRACT

In the team literature there is much discussion about free-riding as a main obstacle for teams to achieve quality performance. Given its importance to team success, however, empirical study of the free-rider problem has lagged behind the conceptual work. So far, little research has been conducted in field settings to measure the scale of free-riding and investigate how the problem may deteriorate the productivity of collective actions. This study intends to examine the free-rider problem in project teams. 44 student software development teams participated in the study. An instrument was developed to capture the most salient free-riding behavior from team members; a research model with team morale and team size as the antecedents, and team cognition and team performance as the consequences of free-riding, was tested. Implications to both research and team practices are discussed.

Keywords

Free-riding, moral hazard, organizational citizenship behavior, team cognition, team performance.

INTRODUCTION

Modern organizations have widely adopted the team approach as a way of accomplishing tasks which surpass the capabilities of single individuals (Glassop, 2002). Teams are viewed as "group(s) of two or more individuals who must interact cooperatively and adaptively in pursuit of shared valued objectives" (Cannon-Bowers et al., 1993; p. 223). To achieve team success, team members should engage in collective actions and restrict certain individual activities whose purposes are incompatible with or even contradictory to team objectives. Of the un-desirable behaviors, free-riding has long been argued as a main obstacle for teams to achieve quality performance (Olson, 1965; Price, 2006; Anesi, 2009).

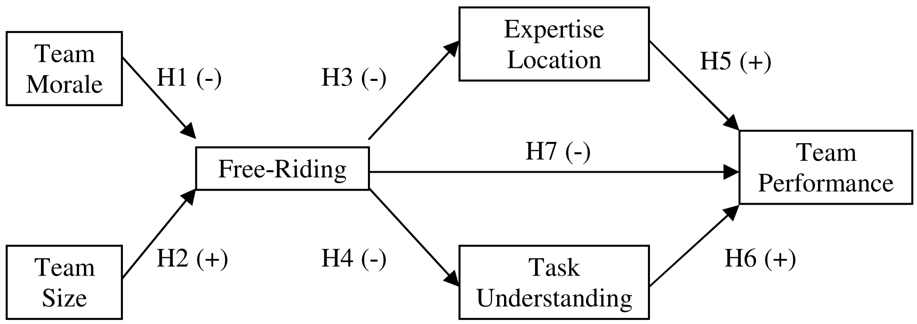
Free-riding, also labeled as social traps (Platt, 1973), commons problem (Edney, 1980), commons dilemma (Dawes et al., 1977), assurance problem (Runge, 1984), and moral hazard in teams (Anesi, 2009), refers to an undesired behavior that a member of a group obtains benefits from group membership but does not bear a proportional share of the costs of providing the benefits (Albanese and Van Fleet, 1985). Free-riding deteriorates team productivity by tempting team members to be free-riders and shirk in collective actions.

Given its importance to team success, many studies have been conducted to understand, and develop means to cope with, the detrimental behavior of free-riding. Early group and organizational theorists have focused on the causes of free-riding under the theoretical umbrella of public goods (e.g., Olson, 1965; Stroebe and Frey, 1982; Runge, 1984; Albanese and Van Fleet, 1985); experimental studies derived from the prisoner's dilemma game (Luce and Raiffa, 1957) have been conducted to study how group size, nature of task (mostly temporary tasks), and individual differences affect one's tendency of free-riding (for a review, see Albanese and Van Fleet, 1985); recent research in this area employs mathematic modeling and studies reward/sanction systems under which free-riding behaviors can be discouraged (e.g., Dijk et al., 2001; Price, 2006; Anesi, 2009). Empirical study has largely lagged behind the conceptual work. So far, little research has been conducted in field settings to measure the scale of free-riding and investigate the extent to which the problem deteriorates the productivity of collective actions.

To fill the research gap, this study intends to examine the free-rider problem in project teams. The paper is organized as follows. After reviewing the research of free-riding, organizational citizenship behavior (OCB), and team cognition in social and organizational behavior, a research model was proposed with team morale and team size as the antecedents, and team cognition and team performance as the consequences, of free-riding. A research strategy was designed to use student software development teams as the research subject. An instrument was developed to capture free-riding behaviors from team members. After empirical testing of the research model, the results and implications of the study are discussed.

THEORETICAL FOUNDATIONS AND HYPOTHESES

This study intends to investigate the antecedences as well as the consequences of free-riding in team settings. A research model is presented in Figure 1.



Note:

1. Signs indicate a hypothesized effect is positive or negative;

Figure 1. Research Model

Free-riding

The notion of free-riding can be backdated to the early seminal work of Olson (1965). Of the large literature on inefficiencies in collective actions, all studies point the free-rider problem as a main obstacle to achieve the desired outcomes (Anesi, 2009). The cause of free-riding is rather intuitive. Price (2006) summarized the cause as below:

> "If each member receives an equal share of the benefit that the group produces, no matter how much that member contributed to the production effort, then each member has a private incentive to contribute less than co-members. This incentive to freeride exists because if all members benefit equally, then the members who contributed the least to production will reap the highest net benefits (p. 20)."

Underlying the above analysis are two assumptions about human nature: (1) people are egotistic so that personal interests always surpass collective benefits of others; and (2) people are conscious so that they tend to perform activities whose perceived benefits outweigh perceived costs. Thus, the literature suggests two solutions to the free-rider problem: (1) designing reward systems to direct social benefits toward cooperators, and/or (2) designing sanction systems to impose social costs on freeriders (Yamagishi, 1986; Hawkes, 1993; Fehr and Gächter, 2000; Andreoni et al., 2003; Price, 2006). The element of the two solutions is the same: reducing the incentive (the difference between the estimated benefits and costs) to free-ride in order to encourage one's participation in collective activities.

However, designing new reword/sanction systems could be very challenging, if not impossible, in many situations. Other approaches need to be explored to address the free-rider problem. The research of OCB provides another perspective on studying this issue.

Team Morale and Organizational Citizenship Behavior

People are not always self-centered. Researchers have noted the existence of altruistic behavior in organizational settings where people make voluntary efforts at work beyond prescribed specifications and tasks. Such behaviors are labeled as Organizational Citizenship Behavior (OCB) in the literature. OCB that was derived from the Organ's (1988) work has received the most research attention (Hoffman et al., 2007). According to Organ (1988), OCB refers to:

> "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization. By discretionary, I mean that the behavior is … rather a matter of personal choice, such that its omission is not generally understood as punishable" (p. 4).

OCB can be viewed as an extreme opposite of free-riding behaviors. Free-riding is driven by personal interests, while OCB promotes collective benefits by performing voluntary activities. OCB research implies alternative solutions to counteract free-riding without the burden of designing new reward/sanction systems.

A meta-analysis of the OCB literature supports the conclusion that job attitudes are robust predictors of OCB (Organ and Ryan, 1994). Researchers make suggestions to organizations to maintain high morale among workforce such as work attitudes and job satisfaction for favorable behaviors such as OCB (Randall et al., 1999). In a study of temporary workers, researchers find that employees with strong job commitment and motivations to taking assignments present high levels of OCB in client organizations (Moorman and Harland, 2002).

By definition, the presence of OCB means the lack of free-riding behaviors. People who have positive attitudes and strong commitments about their work are less likely to be free-riders when working with their colleagues. In cohesive social networks such as project teams, people's perceptions of and attitudes about their assignments are largely determined by social influence from peers (Salancik and Pfeffer, 1978; Meyer, 1994). Thus, a team's collective attitudes about team tasks (defined as team morale in the study) will affect individuals' attitudes, and therefore their behaviors, of participating in team actions. In the team, the more positive collective attitudes are about the tasks (or higher level of team morale), the less likely a team member will shirk in team activities and be a free-rider.

Hypothesis 1: Team morale has a negative effect on the scale of free-riding in the team.

Team Size

The free-rider problem is rooted in the rational comparison between the expected benefits and estimated costs of free-riding (Olson, 1967; Price 2006). The difference, viewed as an incentive, grows with the number of people involved in the target collective action (Albanese and Van Fleet, 1985; Anesi, 2009). Compared with small groups, individuals in large groups are more likely conclude that there is no perceptible difference between contributing and not contributing, therefore increasing the tendency of free-riding (Albanese and Van Fleet, 1985). Thus, large teams/organizations are expected to be the most affected by the free-rider problem.

Hypothesis 2: Team size has a positive effect on the scale of free-riding in the team.

Team Cognition and Team Performance

Team cognition refers to the mental models collectively held by a group of individuals which enable them to accomplish tasks by acting as a coordinated unit. This team-level integration of mental models functions as a mental template which is imposed on information environments to give them form and meaning, providing a cognitive foundation for action (Walsh, 1995).

The concept of team cognition has been proposed as a valid theoretical lens for examining team interactions (Cannon-Bowers et al., 1993; Cooke et al., 2000; Klimoski and Mohammed, 1994). Effective teams need to exchange and process information and knowledge among team members. Such team interactions require both time and cognitive resources (MacMillan et al., 2004). Team cognition enables members to formulate accurate teamwork and taskwork predictions (Cannon-Bowers et al., 1993; Katz and Tushman, 1979), adapt their activities and behaviors in a collaborative way, and thereby increase overall team effectiveness (Cannon-Bowers and Salas, 2001; Lewis, 2004). Without well-formed team cognition, team members will not be able to efficiently share knowledge and information, coordinate each other's activities, resolve conflicts, or negotiate agreed-upon solutions (Cannon-Bowers and Salas, 2001; Jackson et al., 1995; Walsh, 1995).

There are different types of team cognition (for a review, see Cannon-Bowers and Salas, 2001). Among them, team types and task types of team cognition are most relevant for team performance (Mathieu et al., 2000). In a recent study of student software development teams, He et al. (2007) identify shared awareness of expertise location and shared task understanding as two key dimensions of team cognition. Shared awareness of expertise location refers to members' shared awareness of other members' knowledge and expertise in the team; shared task understanding refers to the mutually shared understanding of a focal task among team members.

The development of team cognition requires frequent interactions among team members such as communications and working together (He et al., 2007). Free-riding, however, impedes the development of team cognition by inducing individuals to shirk from collective actions. Regarding the two dimensions of team cognition, I propose:

Hypothesis 3: The scale of free-riding has a negative effect on the level of shared awareness of expertise location in the team.

Hypothesis 4: The scale of free-riding has a negative effect on the level of shared task understanding in the team.

The team cognition research has repeatedly observed that teams perform better if they have developed mature team cognition (Liang et al., 1995; Hollingshead, 1998; Moreland and Myaskovsky, 2000; Lewis, 2004; He et al., 2007). The empirical evidence supports team cognition as an important determinant for the effectiveness of working teams (Walsh, 1995; Cannon-Bowers and Salas, 2001; Mohammed and Dumville, 2001).

Hypothesis 5: The level of shared awareness of expertise location has a positive effect on team performance.

Hypothesis 6: The level of shared task understanding has a positive effect on team performance.

While team cognition may strongly mediate the effects of free-riding on team performance, previous studies have not assessed the extent of the mediation. As an exploratory study on the issue, I propose that team cognition partially mediates the negative effects of free-riding on team performance.

Hypothesis 7: The scale of free-riding has a negative effect on team performance after controlling the effects of shared awareness of expertise location and shared task understanding.

RESEARCH DESIGN

The study selected student software development teams as the research subject. Beyond the practical advantage of sampling convenience, the decision was made mainly for the expected homogeneity among student backgrounds, which would lower the risk of unexpected confounding effects caused by diversity among ages, experiences, organizational culture, management levels etc.

A synthetic software development task was designed to test the research model. Synthetic tasks are "research tasks constructed by systematic abstraction from a corresponding real-world task" (Martin et al., 1998; p. 123). Performance on a synthetic task should exercise some of the same behavioral and cognitive skills associated with the real-world task, while avoiding the complexity (for example, the existence of various confounding factors that may lower the opportunity of observing significant effects of the investigated factors) encountered in an uncontrolled field study of real tasks.

The synthetic task employed in this study was the development of a relational database system using Microsoft Access. Except for team formation and task deadline, participants were free to set their own schedules and procedures to carry out their tasks, simulating the software development process in a realistic manner.

Participants

143 undergraduates enrolled in an information systems course formed teams to fulfill a course requirement of collaboratively developing a relational database system over a 5-week period. The students were juniors (about 24%), seniors (about 65%), and fifth-year business majors (about 11%). When the project was assigned, students were instructed to form three-member teams and were allowed to make their own teammate selections. Some students selected acquaintances as teammates, while others chose students who happened to be seated nearby. Forty-four teams were formed: 7 teams with two members, 19 teams with three members, and 18 teams with four members.

Data Collection

During the software development process, students were asked to answer an online survey regarding their participation and team performance every week over a four week period. The first survey was conducted one week after the start of the project. Although encouraged by the course instructor, taking the survey was voluntary. Students were told that the survey responses would not influence their grades in any way. Some students failed to answer the survey on time, and some submitted incomplete answers. This resulted in 492 usable sets of individual data for analysis, or an 86.5% effective response rate.

Measurement

Free-riding: So far, free-riding has been studied largely with mathematical models and conceptual discussions. There is no commonly-accepted measure in the literature to assess the scale of free-riding in team settings.

Unlike other team-level measures such as team performance, free-riding is to detect and assess the undesirable shirking behaviors from few, not all, team members on assigned team tasks. Thus, a potential instrument should be carefully designed to capture the lowest level, rather than the average level, of participation among team members. Based on discussion with students as well as personal experiences, I developed an instrument with two-step questions to measure the level of the lowest participation in teams. Students were first asked to identify a teammate who had contributed the least in their teams. Then, they were asked by nine questions to assess the level of participative activities performed by the teammate. The rationale of this design was explained explicitly on the questionnaire: low levels of participation on team assignments will be viewed as free-riding; if the reported participation of the least involved teammate is of high levels, the team will be assessed with no or little free-riding.

Other Measures: In this study, team morale, team size, team cognition including shared awareness of expertise location and shared task understanding, and team performed were measured to test the research model. Team morale was measured by a six-item instrument about members' attitudes (or the perceived importance) of their team assignments; shared awareness of expertise location and shared task understanding were each measured by a four-item instrument adopted from He et al. (2007). Team performance was measured by a five-item instrument adapted from Robey et al. (1993). Individual responses of these measures will be averaged within teams to form team-level data for testing.

These instruments are reported in the Appendix.

RESULTS

Construct Validity

The test of construct validity was conducted with Partial Least Squares (PLS) – a structural equation modeling (SEM) technique that has been commonly used in IS research. Similar to other SEM techniques (e.g., LISREL), PLS tests the validity of constructs and the structural model at the same time, and is therefore considered methodologically rigorous when compared with regression-based techniques who separate the test of construct validity (e.g., factor analysis) from the test of the research model (Gefen et al., 2000). Two other distinctive features of PLS made the technique a particularly suitable testing tool for this study:

1. PLS has the flexibility of accepting single-item constructs (i.e., team size in this study);
2. The algorism of PLS, which is component-based rather than covariance-based, allows the modeling of formative indicators (Chin 1998). In this study, the construct of free-riding was modeled as formative indicators based on its conceptulizations and operationalizations (questions asking the performance of a certain set of activities).

The design of the new instrument of free-riding suggests the measure be modeled as a formative indicator in hypothesis testing. Conventional procedures used to assess the validity of reflective constructs (e.g., factor analysis) may not be appropriate for assessing the validity of formative constructs (Diamantopoulos and Winklhofer, 2001). In this study, a multitrait-multimethod (MTMM) method with special modification for assessing formative constructs (Loch et al., 2003) was used to examine the convergent and discriminant validity of a new measure of free-riding. This method is also practiced in Marakas et al. (2007) for the development of different types of computer self-efficacy.

In this method, a composite score of each formative indicator was calculated based on the sum of products between its formative items and their associated weights. The weight represents the extent to which an item contributes to the overall value of a latent variable. A correlation matrix is then calculated between items of formative constructs and all constructs under study. To establish convergent validity, items should correlate high with items measuring the same construct, and low with items measuring other constructs. To establish discriminant validity, items should correlate high with the assigned constructs and low with unassigned ones. Following the guideline, the resulted correlation matrix was examined and all the abovementioned rules were satisfied. Thus, the validity of the formative construct of free-riding was concluded.

Assessing the validity of reflective items follows the conventional practice based on the examination of construct reliability, convergent validity, and discriminant validity. Construct validity can be assessed by composite reliability calculated in PLS (should be larger than 0.70). Convergent validity can be assessed by the average variance extracted (AVE) among measures (should be larger than 0.50). Discriminant validity can be assessed by comparing the square root of AVEs and inter-construct correlations – the former should be larger than the latter to support disciminant validity. Close examination of Table 1 suggested that all the conditions were satisfied. Thus, validity of the reflective indicators under study was concluded.

	Reliability	1	2	3	4	5	6	7
1. Team Morale	0.97	**0.922**						
2. Team Size	1	0.173	**1**					
3. Free-Riding†	-	-0.615	0.037	-				
4. Expertise Location	0.96	0.310	0.226	-0.266	**0.927**			
5. Task Understanding	0.95	0.487	0.244	-0.357	0.619	**0.91**		
6. Team Performance	0.96	0.422	0.243	-0.312	0.589	0.671	**0.91**	
7. Time of Measurement	1	0.063	0.011	-0.037	0.364	0.286	0.369	**1**

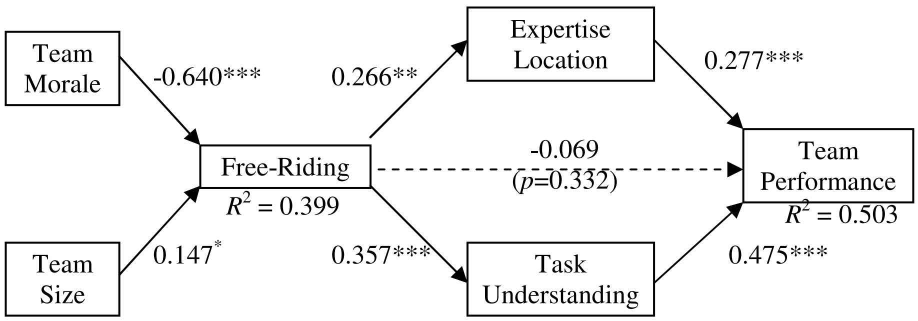
Notes:

1. Reliability: composite reliability calculated in PLS
2. Numbers in bold on the leading diagonal are the square root of the average variance extracted (AVE) among reflective measures. For discriminant validity of constructs, diagonal elements should be larger than off-diagonal elements.
3. Off diagonal elements are correlations among constructs.
4. † Free-riding is modeled as formative indicators in the study. Calculations of construct reliability and shared variance are not relevant for the construct.

Table 1. Inter-Construct Correlations

Hypothesis Testing

The test of the research model and the results are presented in Figure 2. Examination of the resulting path significances suggested that most hypotheses were supported by the data sample at α=0.05 level. The effect of free-riding on team performance, after controlling the two team cognition dimensions (i.e., shared awareness of expertise location and shared task understanding), however, was found to be insignificant (p=0.332). The results suggest that the effect of free-riding on team performance is fully mediated by team cognition.



Note:

1. Dashed lines indicate insignificance with p>0.05 (2-sided).
2. * p=0.053; ** p<0.01; *** p<0.001 (2-sided)

Figure 2. Testing Results

SUMMARY AND DISCUSSION

Few people doubt the deteriorating effects of free-riding on collective actions. But to what extent does free-riding impair team performance? The data from the sampled student software development teams shows that the negative effect of free-riding on team performance is significant and moderately large (r = -0.312, p < 0.001). Such effect is fully mediated by team cognition (measured by shared awareness of expertise location and shared task understanding). This finding suggests that the free-rider problem impairs team performance by impeding the development of collective mental models among team members.

As expected, team morale was found to be negatively associated with, and team size was positively associated with, the scale of free-riding in the sampled teams. This result suggests that developing positive attitudes (or perceived importance) of the assigned team tasks and reducing team sizes are two effective means for counteracting free-riding among team members. One may note that the effect of team size was marginally significant (p=0.053) in Figure 2. Considering the comparatively low diversity among team sizes (the sampled teams had two, three, or four members in each team), the influence of team size on free-riding should not be ignored. In large software development teams (common in real business settings), the attention on each individual team member may be diluted by the number of participants in the team as well as the increased complexity of team tasks. Teammates often have limited knowledge or awareness on the particular task that one is working on. Thus, reducing team size could be an effective method of counteracting free-riding by increasing peer pressure on one's participation. Future research with large teams is needed to clarity the issue.

The research model does not include the time variable, which has recently received increased attention in IS research (Sarker and Sahay, 2004; Saunders, 2007). The team literature has long recognized the influence of time on team behavior (Tuckman, 1965; Wheelan and Hochberger, 1996). For example, team transition model (Gersick, 1989) argues that the urgency of deadlines helps teams alternate the inertia in team behaviors and themes through which they approach their work. As time passes, the awareness of deadline will alert team members the necessarily of adjusting their behaviors to assure the project being completed within schedule. Thus, one may expect that free-riding will decrease with the progress of the project. This is not observed in the sampled teams. The correlation between the time of measurement and the scale of free-riding was found to be insignificant (reported in Table 1). Future research is needed to clarify the effect of time on free-riding.

Although the results are encouraging, the study has several limitations. One is about the measurement of free-riding. Free-riding was measured by a newly development instrument rather than an existing measure from the literature. The development of the new instrument can be viewed as a contribution to the field; however, the validity of the new instrument needs to be tested in future studies.

All the constructs except team size were self-reported by sampled students. Thus, common-method bias could be another concern for the study. By aggregating individual responses to form team level measures, this concern may be alleviated in that multiple responses could cancel out each other's errors. To assess the extent of common method variance, I performed Harman's single factor test by loading all of the items in this study into an exploratory factor analysis. Although a widely used diagnostic technique, Podsakoff et. al. (2003) criticized the Harman method for its ambiguity about the source of the variance extracted by a single factor. The extracted variance from the single factor could be caused by the use of common method, lack of discriminant validity, and/or the existence of causal relationships among the investigated constructs.

To assess the source of the extracted variance, I performed two Harman's single-factor tests with the objective measure of team size included and excluded respectively. With team size included, an emerged single factor explained 36.81% of the covariance among the measures. With team size excluded, the variance extracted from a single factor increased to 37.95%. The trivial difference (about 1.1% of the total variance) provides strong evidence that there is no substantial common method variance present.

This study selected student software development teams as the research subject. Thus, special caution is needed when applying the findings to teams of other settings. Student teams differ from other teams in many ways. For example, the incentive systems are weak in student teams mostly because of the lack of severe consequence of free-riding; but in real business settings, failing to meet co-workers' expectations is likely to affect the prosperity of one's career. Future research is desired to test the generalizability of the findings in various contexts.

REFERENCES

1. Albanese, R., Van Fleet, D.D. (1985) "Rational behavior in groups: The free-riding tendency," *The Academy of Management Review*, 10, 2, pp. 244-255.
2. Andreoni, J., Harbaugh, W., and Vesterlund, L. (2003) "The carrot or the stick: Rewards, punishments and cooperation," *American Economic Review*, 93, pp. 893–902.
3. Anesi, V. (2009) "Moral hazard and free riding in collective action," *Social Choice and Welfare*. 32, 2, pp. 197-219.
4. Cannon-Bowers, J.A., and Salas, E. (2001) "Reflections on shared cognition," *Journal of Organizational Behavior*, 22, 2, pp. 195-202.
5. Cannon-Bowers, J.A., Salas, E., and Converse, S. (1993) "Shared mental models in expert team decision making," in Castellan N.J. (ed.) *Individual and Group Decision Making*, Lawrence Erlbaum Associates, NJ: Hillsdale, pp. 221-246.
6. Chin, W.W. (1998) "Issues and opinion on structural equation modeling," *MIS Quarterly*, 22, 1, pp. vii-xvi.
7. Diamantopoulos, A., and Winklhofer, H.M. (2001) "Index construction with formative indicators: An alternative to scale development," *Journal of Marketing Research*, 38, 2, pp. 269-277.
8. Faraj, S., and Sproull, L. (2000) "coordinating expertise in software development teams," *Management Science*, 46, 12, pp. 1554-1568.
9. Fehr, E., and Gächter, S. (2000) "Cooperation and punishment in public goods experiments," *American Economic Review*, 90, pp. 980–994.
10. Gefen, D., Straub, D.W., and Boudreau, M. (2000) "Structural equation modeling techniques and regression: Guidelines for research practice," *Communications of the Association for Information Systems*, 4, 7, pp. 1-78.
11. Glassop, L.I. (2002) "the organizational benefits of teams," *Human Relations*, 55, 2, pp. 225-249.
12. Hawkes, K. (1993) "Why hunter-gatherers work – an ancient version of the problem of public goods," *Current Anthropology*, 34, pp. 341–361.
13. He, J., Butter, B.S., and King, W.R. (2007) "Team cognition: Development and evolution in software project teams," *Journal of Management Information Systems*, 24, 2, pp. 6261-292.
14. Hoffman, B.J., Blair, C.A., Meriac, J.P., Woehr, D.J. (2007) "Expanding the criterion domain? A quantitative review of the OCB literature," *Journal of Applied Psychology*, 92, 2, pp. 555-566.
15. Hollingshead, A.B. (1998) "Group and individual training: The impact of practice on performance," *Small Group Research*, 29, 2, pp. 254–280.

16. Lewis, K. (2004) "Knowledge and performance in knowledge-worker teams: A longitudinal study of transactive memory systems," *Management Science*, 50, 11, pp. 1519-1533.
17. Liang, D.W., Moreland, R.L., and Argote, L. (1995) "Group versus individual training and group performance: The mediating role of transactive memory," *Personality and Social Psychology Bulletin*, 21, 4, pp. 384-393.
18. Loch, K.D., Straub, D.W., and Sherif, K. (2003) "Diffusing the internet in the Arab world: The role of social norms and technological culturation," *IEEE Transactions on Engineering Management*, 50, 1, pp. 45-63.
19. Marakas, G.M., R.D. Johnson, and P.F. Clay (2007) "The evolving nature of the computer self-efficacy construct: An empirical investigation of measurement construction, validity, reliability and stability over time," *Journal of the Association for Information Systems*, 8, 1, pp. 15-46.
20. Martin, E., Lyon, D.R., and Schreiber, B.T. "Designing Synthetic Tasks for Human Factors Research: An Application to Uninhabited Air Vehicles," in *Proceedings of the Human Factors and Ergonomics Society 42nd annual meeting*, (1998), Santa Monica, CA: Human Factors and Ergonomics Society, pp. 123–127.
21. Mathieu, J.E., Goodwin, G.F., Heffner, T.S., Salas, E., Cannon-Bowers, J.A. (2000) "The influence of shared mental models on team process and performance," *Journal of Applied Psychology*, 85, 2, pp. 273-283.
22. Mohammed, S., and Dumville, B.C. (2001) "Team mental models in a team knowledge framework: Expanding theory and measurement across disciplinary boundaries," *Journal of Organizational Behavior*, 22, 2, pp. 89-106.
23. Moorman, R.H., and Harland, L.K. (2002) "Temporary employees as good citizens: factors influencing their OCB performance," *Journal of Business and Psychology*, 17, 2, pp. 171-187.
24. Moreland, R.L., and Myaskovsky, L. (2000) "Exploring the performance benefits of group training: Transactive memory or improved communication?" *Organizational Behavior & Human Decision Processes*, 82, 1, pp. 117-133.
25. Nonaka, I., and Takeuchi, H. (1995) *The Knowledge-creating Company*, Oxford University Press, New York.
26. Olson, M. (1965) *The logic of collective action*, Harvard University Press, Cambridge.
27. Organ, D.W. (1988). *Organizational citizenship behavior Lexington*, Heath and Co, MA: D.C.
28. Organ, D.W. and Ryan, K. (1995) "A meta-analytic review of attitudinal and dispositional predictors of organizational citizenship behavior," *Personnel Psychology*, 48, pp. 775-803.
29. Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., and Podsakoff, N.P. (2003) "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *Journal of Applied Psychology*, 88, 5, pp. 879-903.
30. Price, M.E. (2006) "Judgments about cooperators and freeriders on a Shuar work team: An evolutionary psychological perspective," *Organizational Behavior and Human Decision Processes*, 101, 1, pp. 20-35.
31. Randall, M.L., Cropanzano, R., Bormann, C.A., and Birjulin, A. (1999) "Organizational politics and organizational support as predictors of work attitudes, job performance, and organizational citizenship behavior," *Journal of Organizational Behavior*, 20, 2, pp. 159-174.
32. Robey, D., Smith, L.A., and Vijayasarathy, L.R. (1993) "Perceptions of conflict and success in information systems development projects," *Journal of Management Information Systems*, 10, 1, pp. 123-139.
33. Sarker, S., and Sahay, S. (2004) "Implications of space and time for distributed work: an interpretive study of US–Norwegian systems development teams," *European Journal of Information Systems*, 13, 3-20.
34. Saunders, C. (2007) "Editor's comments: Perspectives on time," *MIS Quarterly*, 31, 4, iii-xi.
35. Smith-Jentsch, K.A., Campbell, G.E., Milanovich, D.M., and Reynolds, A.M. (2001) "Measuring teamwork mental models to support training needs assessment, development, and evaluation: Two empirical studies," *Journal of Organizational Behavior*, 22, 2, pp. 179-194.
36. Tuckman, B.W. (1965) "Developmental sequences in small groups," *Psychological Bulletin*, 63, pp. 384-399.
37. Van Dijk, F., Sonnemans, J., and van Winden, F. (2001) "Incentive systems in a real effort experiment," *European Economic Review*, 45, 2, pp. 187-214.

38. Walsh, J.P. (1995) “Managerial and organizational cognition: Notes from a trip down memory lane,” *Organization Science*, 6, 3, pp. 280–321.
39. Wheelan, S.A., and Hochberger, J.M. (1996) “Validation studies of the group development questionnaire,” *Small Group Research*, 27, 1, pp. 143-170.
40. Yamagishi, T. (1986) “The provision of a sanctioning system as a public good,” *Journal of Personality and Social Psychology*, 51, pp. 110–116.
41. Luce, R.D., and Raiffa, H. (1957) *Games and Decisions*, Wiley, New York.
42. Brubaker, E.R. (1975) “Free ride, free revelation, or golden rule?” *Journal of Law and Economics*, 18, 1, pp. 147-161.
43. Dawes, R.M., McTavish, J., and Shaklee, H. (1977) “Behavior, communication, and assumptions about other people's behavior in a commons dilemma situation,” *Journal of Personality and Social Psychology*, 5, 1, pp. 1-11.
44. Edney, J.J. (1980) “The commons problem: Alternative perspectives,” *American Psychologist*, 35, 2, pp. 131-150.
45. Platt, J. (197) “Social traps,” *American Psychologist*, 28, 8, pp. 641-651.
46. Visser, P.S. (2002) “Attitudes in the social context: The impact of social network composition on individual-level attitude strength,” *Journal of personality and social psychology*, 87, 6, pp. 779-795.
47. Meyer, G.W. (1994) “Social information processing and social networks: A test of social influence mechanisms,” *Human Relations*, 47, 9, pp. 1013-1047.
48. Stroebe, W., and Frey, B.S. (1982) “Self-interest and collective action: The economics and psychology of public goods,” *British journal of Social Psychology*, 21, pp. 121-137.
49. Runge, C.F. (1984) “Institutions and the free rider: The assurance problem in collective action,” *The Journal of Politics*, 46, 1, pp. 154-181.
50. Salancik, G., and Pfeffer, J. (1978) “A social information processing approach to job attitudes and task design,” *Administrative Science Quarterly*, 2, pp. 224-253.

APPENDIX

Free-riding (a two-step measure)

Step 1: Now recall the whole project development process. Select a member who has contributed to the project the least in your group (other than you). Note: if the person you selected has contributed a lot (as reflected in the next set of questions), it means that everyone has worked hard on this project and there is no free-rider in your team.

Step 2: Do you agree with the following statements regarding the person's contribution to the project?

1. The person did NOT participate in group meetings.
2. The person did NOT communicate with other members.
3. The person could NOT be reached by email or telephone.
4. The person did NOT take responsibility for his/her part of the project development.
5. The person did NOT contribute any creative idea to the project.
6. The person did provide meaningful suggestions/advices to the project.
7. The person's knowledge has great significance to this project.
8. Compare with my efforts, I think the person has contributed significantly to the group project.
9. Overall, the person has contributed a lot to this project.

Team Morale (a collective measure of attitudes toward team assignments)

Do you agree that you and your fellow members believe ...

1. This assignment is important to all team members.
2. Everyone should work hard on this assignment.
3. Everyone should commit heavily to this assignment.
4. Nobody should "escape" from doing the assignment.
5. Teamwork is important to your group's success.
6. People should work closely to get the job done.

Shared awareness of expertise location

Do your team members know each other's skills and expertise...

1. The team had a good "map" of each other's talents and skills.
2. Team members were assigned to tasks commensurate with their task-relevant knowledge and skill.
3. Team members knew what task-related skills and knowledge they each possess.
4. Team members knew who on the team has specialized skills and knowledge that is relevant to their work.

Shared Task Understanding

Do you agree with the following statements?

1. Team members had a common understanding of the application domain (i.e., inventory management) that the system was supposed to support.
2. Team members had a common understanding of the technologies used in the development process.
3. Team members had a common understanding of the project development procedures.
4. Overall, team members shared their visions of the project.

Team Performance

Please evaluate performance of the project team in the past one week regarding ...

1. the amount of work the team produced.
2. the efficiency of team operations.
3. the team's adherence to the schedule.
4. the quality of work the team produced.
5. the effectiveness of the team's interactions with people outside the team.